



# **Armed Forces College of Medicine AFCM**



# **The motor descending tracts (II)**

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## ***INTENDED LEARNING OBJECTIVES (ILOs)***



By the end of this lecture the student will be able to:

1. Describe physiological role of extrapyramidal tracts.
2. Discuss effects of Lesions of extrapyramidal tracts.
3. Explain the mechanism of cortical control on axial and distal muscles.

# *Extra pyramidal System (Indirect Activation Pathway)*



## Origins:

1. CMAs (area 6 &
2. Basal Ganglia.
3. Brain stem.

## Tracts:

1. Rubrospinal.
2. Tectospinal.
3. Vestibulospinal.
4. Reticulospinal.

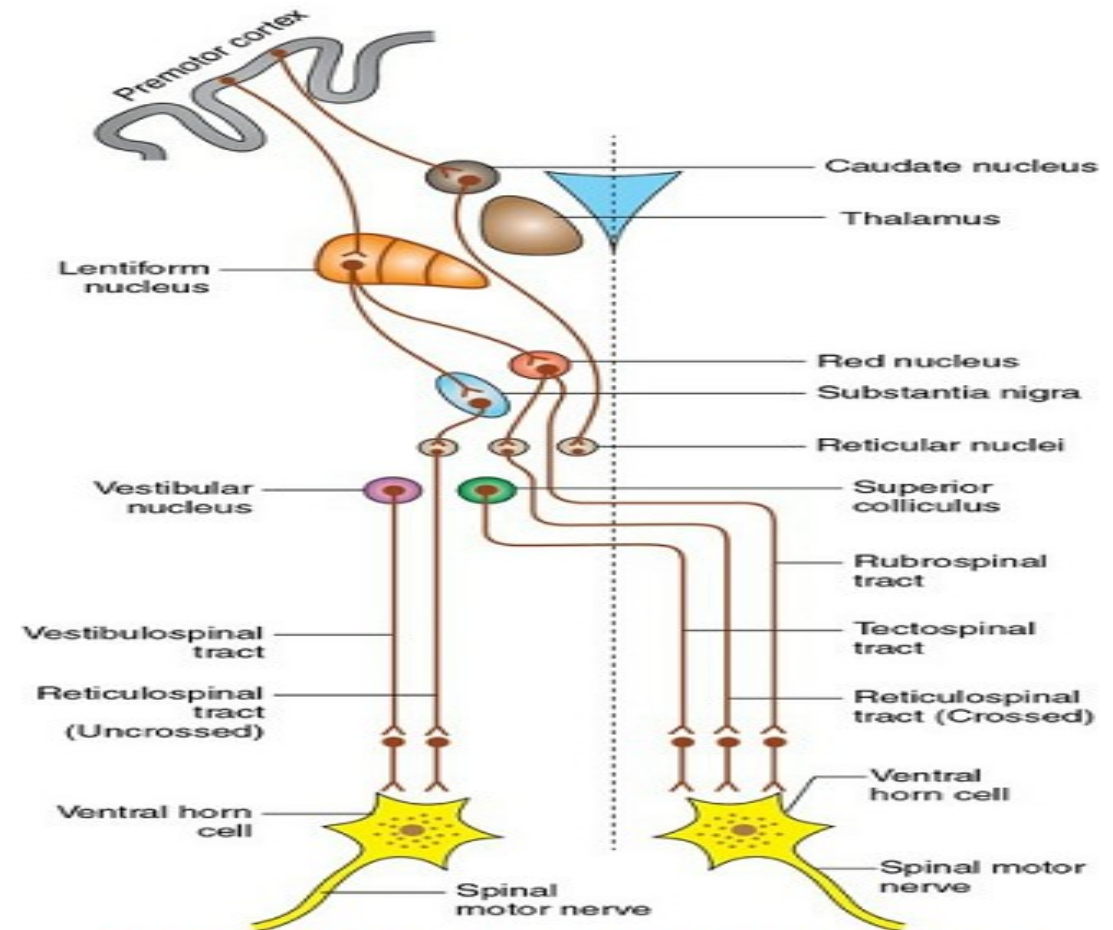


FIGURE 10.9-3 The extrapyramidal tracts.

Textbook of Medical Physiology, SECOND EDITION,  
Indu Khurana, MD, 2015, Elsevier

## ***Extra pyramidal System***



**CST, cortical origin extrapyramidal fibers** (that relay in red nucleus) and vestibulospinal tract

→ end on **opposite α motor neurons** of the spinal cord (90% on Interneuron's & 10% directly).

Other **cortical origin extrapyramidal fibers** reach directly (or via **basal ganglia**) → **inhibitory (medullary) reticular formation**

→ control **γ motor neurons** of the spinal cord.

# ***Extra pyramidal System***



## ***N.B.***

LMNs of body muscles are controlled by:

- **Pyramidal** tract: **CST**.

- **Extrapyramidal** tract: **Cortical origin extrapyramidal fibers** that  
relay in **red nucleus**

-Head & face muscles are supplied only by Pyramidal tract: **CBT**.

# *Extra pyramidal System*



## Function of extrapyramidal system:

1. Performance of **gross** movements of **axial** muscles (neck-trunk) and **proximal limb** muscles
2. Performance of **subconscious** movement (e.g. arm swinging during walking).
3. **Movement of head and eyes** towards visual or auditory stimuli.
4. **Inhibitory** to stretch reflex.
5. **Postural adjustment** to:
  - Maintain up-right posture.
  - Maintain equilibrium.
  - Provide the background of skilled acts.
6. Control **autonomic** functions.

## ***Descending Motor Tracts***



<b>Extrapyramidal system</b> ( <b>Indirect</b> Activation Pathway)	<b>Pyramidal System</b> ( <b>Direct</b> Activation Pathway)	
COEP + Basal ganglia+ Brain stem	Only cortical	<b>1. Origin</b>
About 50% crossed.	Nearly all crossed	<b>2. Crossing</b>
Multi-neuronal	Mono-neuronal	<b>3. Tract</b>
A.H.C. (spinal cord)	A.H.C. (spinal cord) Motor cranial nuclei (Brain Stem)	<b>4. Termination</b>
a) Inhibitory to Stretch R. b) Control of gross movements mainly + autonomic functions.  <b>N.B:</b> start function <b>at birth</b> .	a) Excitatory to Stretch R. b) Control of fine discrete movement  <b>N.B:</b> start function after age of <b>one year</b> , after myelination.	<b>5. Function</b>
Both Lost together = UMNL (No practical separate lesion)		<b>6. Lesion</b>

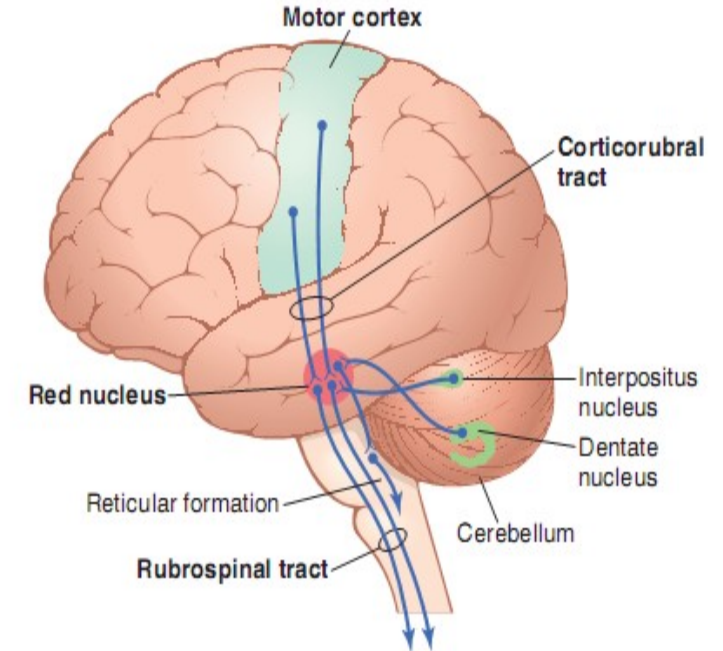


# Rubrospinal Tract



## Functions:

- Serves as an **accessory route** for transmission of relatively discrete signals from motor cortex to spinal cord. (for fine **skilled movements**).
- It mediates **cerebellum signals** to spinal cord. (mediates comparator function of cerebellum)
- **Inhibits** deep reflexes and muscle tone.
- **Activate** flexors and inhibit



Guyton and Hall,  
2016

# ***Rubrospinal Tract***



## **Lesions:**

**Damage of lateral corticospinal fibers + intact rubrospinal pathway**

**Impaired fine movements of fingers and hands + intact wrist movements**

**Lesion in both lateral corticospinal and rubrospinal pathways**

**Loss wrist movements & fine movements of fingers and hands.**

# ***Reticulospinal Tract***



## **Pontine** reticulospinal tract:

Excitatory (↑ ↑ muscle tone in antigravity extensors)  
Spontaneously active

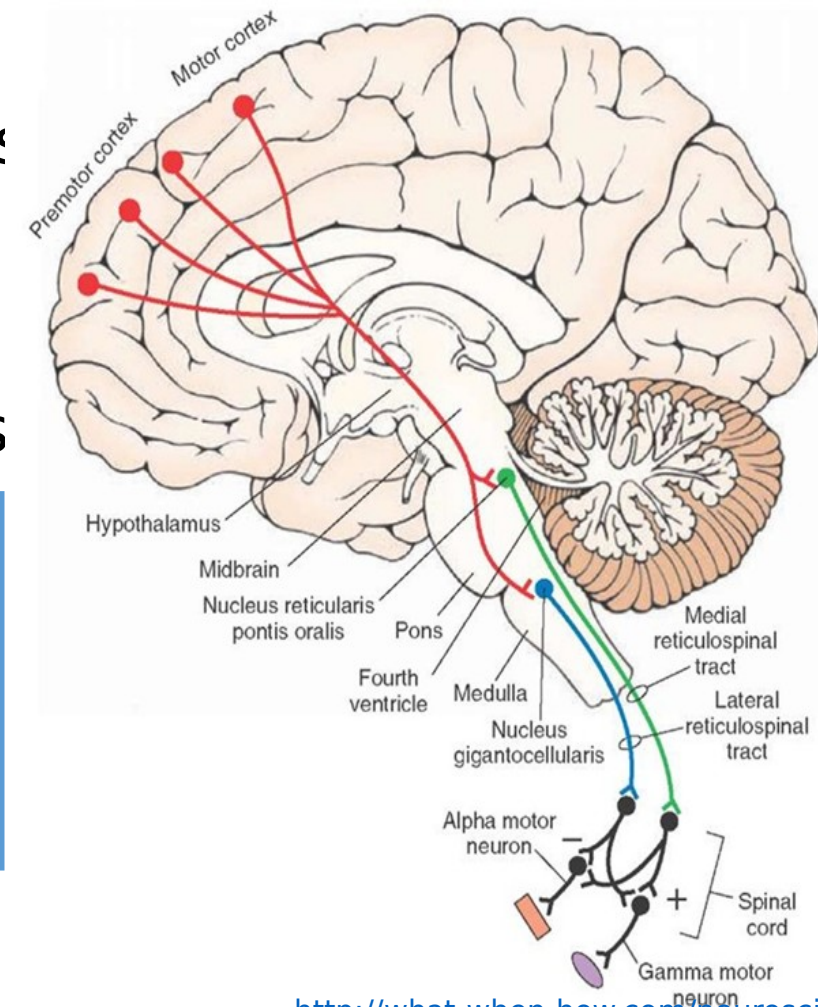
## **Medullary** reticulospinal tract:

Inhibitory (↓ ↓ muscle tone in antigravity extensors)

Normally, the **inhibitory medullary signals** counterbalance the **excitatory pontine signals**, so under normal conditions the body muscles are not abnormally tense.

## **Functions:**

- Maintenance of **posture**.
- Modulate **muscle tone**, especially via influence on **γ-motor neurons**



<http://what-when-how.com/neuroscience/the-reticular-formation-integrative-system-part-3/>

# ***Vestibulospinal Tract***



## **Function:**

- Involved in **vestibular function** (Equilibrium).
- It activates **antigravity muscles** (trunk and proximal limb **extensors**) to control posture and balance.
- Facilitatory to **muscle tone**.

**Vestibulospinal Tract** functions in association with the **pontine reticulospinal tract** to control **antigravity muscles** (extensors mainly).

Without this support of vestibular nuclei, the pontine reticular system would lose much of its excitation of **axial**

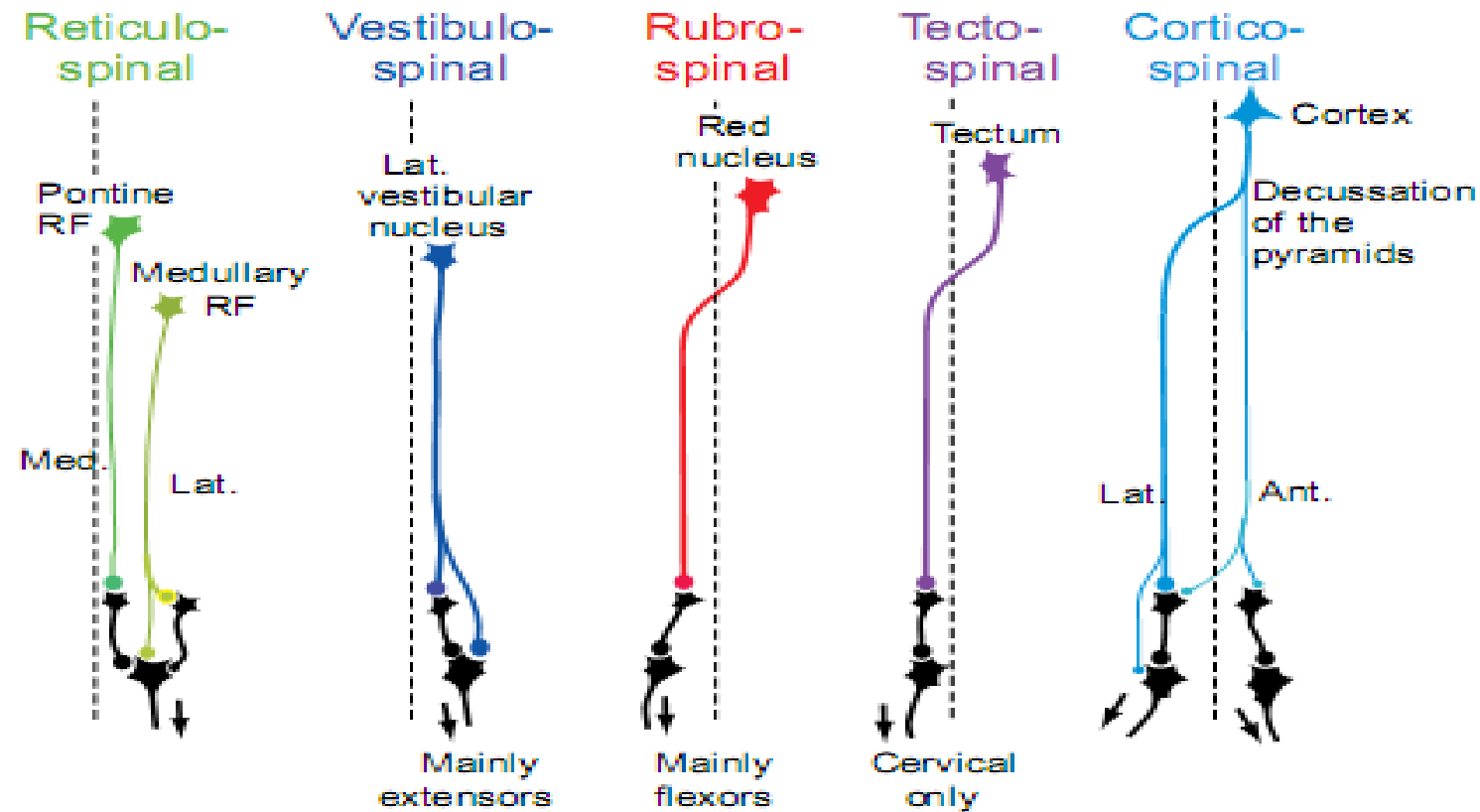


## **Function:**

Controls **head** and **eye movements**

- Reflex turning of head in response to visual stimulus.
- Reflex shift of head in response to auditory stimulus.

# *Descending Motor Tracts*



Neurophysiology A  
conceptual approach, 2012

# Descending Motor Tracts



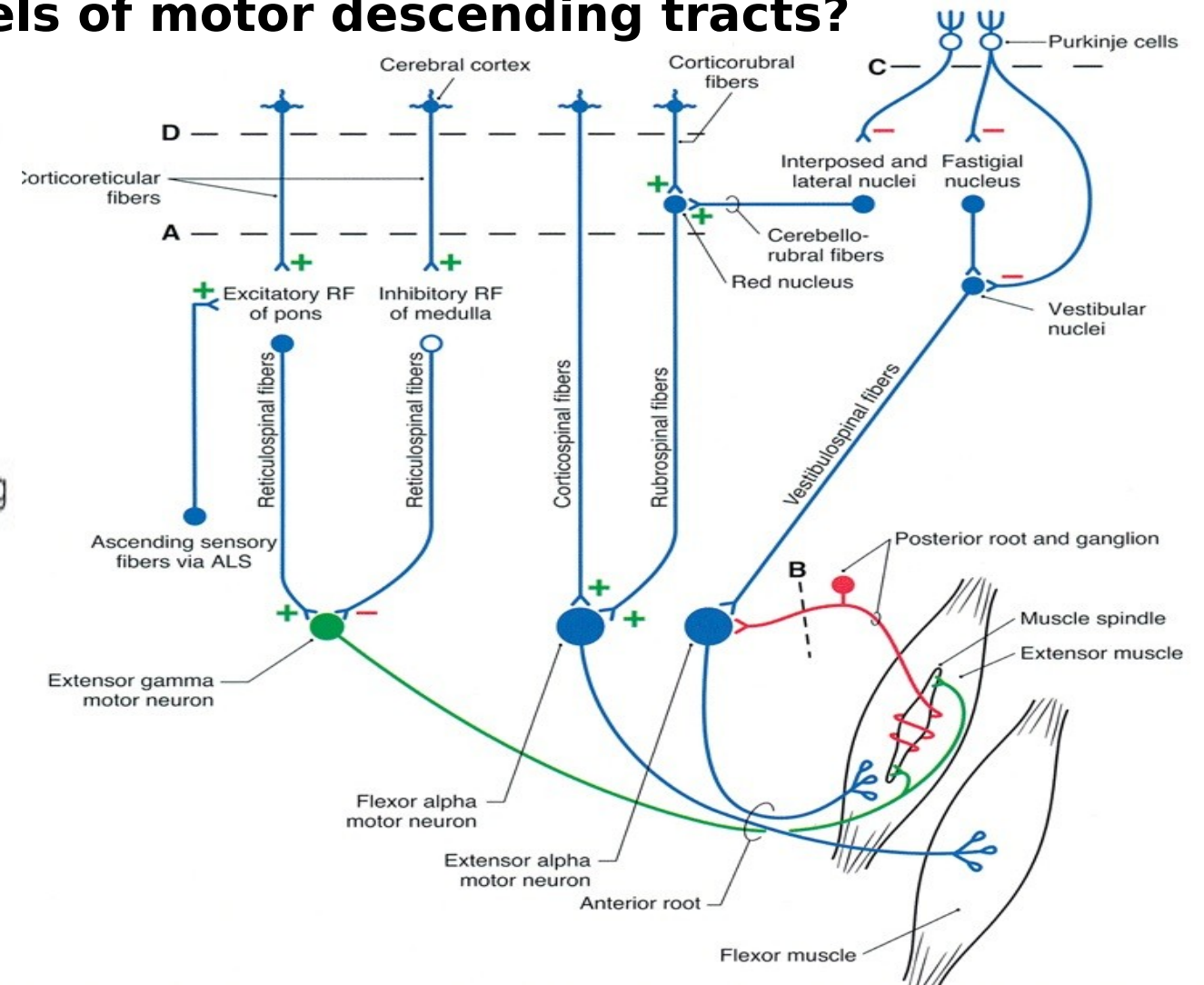
What is the effect of lesions in different levels of motor descending tracts?

## Lesion/Motor response

- A = Extensor rigidity in all limbs, decerebrate rigidity/posturing
- A+B = Relaxation of extensor rigidity in limb with sectioned root
- A+C = Slight enhancement of decerebrate rigidity compared to A
- A+C+B = No relaxation of decerebrate rigidity
- D = Flexion of upper limbs, extension of lower limbs, decorticate rigidity/posturing

Source: Barrett KE, Barman SM, Boitano S, Brooks H: *Ganong's Review of Medical Physiology*,

23<sup>rd</sup> Edition: <http://www.accessmedicine.com>





### **2. Which of the following is true about the extrapyramidal system?**

- A. Originates from cortical areas only.
- B. About 90% of its descending fibers are crossed to the opposite side.
- C. Terminates at alpha & gamma neurons in the sp. cord
- D. Starts its function during and after the first year of life.
- E. Is excitatory to the muscle tone.



# Summary



- Descending motor tracts include 2 systems: pyramidal tracts & extra pyramidal tracts.**
- Descending tracts also can be classified into lateral motor system & medial motor system.**
- Lesion of pyramidal system can cause loss of fine movements and difficulty with balance, standing & walking.**
- Functions of extra-pyramidal system include performance of gross movements of axial and proximal limb muscles.**

## ***SUGGESTED TEXTBOOKS***



1. Guyton and Hall textbook of medical physiology, thirteenth edition 2016, Elsevier, chapter 56 , from page 707 to 719
2. Ganong's Review of Medical Physiology, twenty-fifth edition 2016, McGraw-Hill Education, chapter 12, from page 227 to 254

***Thank You***